NAV 101
Plotting Fixes
Nav 101

- Finding lat/long of an object
- GPS Fix
- Plotting waypoints and a route
- Visual Fix
- Dead Reckoning
- Recording Bearing Log and Navigation Log Entries
- Time Distance Calculations
Determining Lat/Long

Used to determine position of an object - G"95"

- Latitude 39° 00’ 29” N
- Longitude 076° 22’ 48” W
What is the Lat/Long of R“2”?

38° 56’ 29” N
076° 25’ 30” W

What is the Lat/Long of R“90”?

38° 58’ 18” N
076° 23’ 20” W
GPS Fix

Plot the following GPS coordinates

• Latitude
  38° 58’ 30” N

• Longitude
  76° 23’ 55” W

Use proper notation for GPS fix
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Type</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>� libido</td>
<td>Fix</td>
<td>Accurate Visual Fix</td>
</tr>
<tr>
<td>△</td>
<td>Fix</td>
<td>Accurate Fix obtained by any electronic means</td>
</tr>
<tr>
<td>—</td>
<td>DR</td>
<td>Dead reckon position</td>
</tr>
<tr>
<td>❯</td>
<td>EP</td>
<td>Estimated position</td>
</tr>
<tr>
<td></td>
<td>ER</td>
<td><em>Proposed!</em> Estimated reckon</td>
</tr>
</tbody>
</table>
Plot Waypoints and Routes

- Enter lat/long for each waypoint, and label waypoint names CS01, CS02 etc

- Draw route between waypoints in route sequence

- Label route with **magnetic** heading and Distance

C = 180M
D = 8.1NM
A single visual L.O.P. provides the navigator a bearing (line) that the vessel is located on.

A visual fix is determined by 3 visual L.O.P.’s to 3 separate navigation visual aids at the same time:
- Use optimal spread of visual aids
  - If all the navigational aids are on the same side of the vessel they should be 60° (for 3 aids) apart
  - If all visual L.O.P.’s encircle the vessel they should be 120° apart
- Priority of L.O.P.’s
  - If one bearing taker is taking all L.O.P.’s the order that they should be taken is beam, bow, stern

Visual fixes plotted as circle
**Visual Fix**

- Find 3 objects and shoot a bearing with magnetic compass.
- Objects will be identified and labeled on chart during chart prep process, labeled with a “V” for visual, “R” for radar (distinctive land features, RACON buoys).
- Bearing taker and Nav Plotter need to communicate and verify both looking at the same object.
- Draw an LOP on the chart from each of those objects.
- Nav Aids: Use land based nav aids as primary, buoys as secondary.
6 Rules of Dead Reckoning

- Every hour on the hour
- Every course change
- Every speed change
- Every Fix or Running Fix
- Every new Line of Positioning (LOP)
- DR twice and label with Course and Speed
Dead Reckoning

- Formula: Speed (kts) = Distance (nm) / Time (hour)
- How to Plot a DR
  - Speed - 5 kts (Boatspeed)
  - Fix Interval - 12 min
- Manipulate formula
- DR Distance (NM) = Current Speed(KT) x Time(HOUR) DR
  Distance (NM) = 5 kts x .2 hours (12 min) DR Distance (NM) = 1.0 NM

0830 0842 0854

1.0 NM 1.0 NM
Visual Fix Exercise

• Find 3 objects and shoot a bearing with magnetic compass
• Draw an LOP from each of those objects
• Plot your fix and DR on course heading, not course over ground
  - DR Distance = Current Speed X Time (fix interval)
Visual Fix with DR
**Visual Fix Exercise**

- **Course**
  - Eastern Shore
  - Matapeake Tower V-MT 092M
  - Greenbury PT Tower V-GP1 318M
  - Tolly Point Light V-1AH 244M

- **Speed**
  - 5 kts

- **Fix Interval**
  - 6 min
Visual Fix Exercise

Eastern Shore
Matapeake Tower V-MT 092M
Greenbury PT Tower V-GP1 318M
Tolly Point Light V-1AH 244M

Course 190M
Speed 5 kts
Fix Interval 6 min
Bearing Log

- Place: General location
- “Magnetic Only”
- Date (when changed) and time of bearings
- Name of bearing target (each possible target highlighted with yellow circle and labeled per Chart Preparation Checklist)
- Bearing to target
- Depth from vessel depth sounder at time of bearings (to be checked against depth of plotted position)
At 1230, you identify:

- R “2”: 258M (V-R2)
- R “90”: 042M (V-R90)
- G “WR87”: 162M (V-G87)
- Depth: 46’

Record these bearings in your bearing log with proper notation.
<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Bearing 1</th>
<th>Bearing 2</th>
<th>Bearing 3</th>
<th>Depth</th>
</tr>
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<tbody>
<tr>
<td>23-Jan-14</td>
<td>1230</td>
<td>V-R2</td>
<td>V-R90</td>
<td>V-G87</td>
<td></td>
</tr>
<tr>
<td></td>
<td>258</td>
<td></td>
<td>042</td>
<td>162</td>
<td>46</td>
</tr>
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</table>
Create a Fix from LOPs and Soundings

- At 1230, you determine:
  R “2”: 258M
  R “90”: 042M
  G “WR87”: 162M
  Depth: 46’

- Plot the fix.
# Bearing Log

<table>
<thead>
<tr>
<th>Date</th>
<th>Place</th>
<th>Time</th>
<th>Magnetic Only</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>23-Jan-14</td>
<td>V-R2</td>
<td>1230</td>
<td>V-R90</td>
<td>162</td>
</tr>
<tr>
<td></td>
<td></td>
<td>258</td>
<td>V-GR7</td>
<td>V-TPL</td>
</tr>
<tr>
<td>1300</td>
<td></td>
<td>42</td>
<td></td>
<td>V-IAH</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>46</td>
</tr>
<tr>
<td>1300</td>
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<td>082</td>
<td>214</td>
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</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>40</td>
</tr>
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</table>
Determine the latest time for the next fix

- Plot the DR from the fix with your given course, C, and speed, S (knots).
- From the fix, determine the closest distance, D (nm), to shoal water. 2 nm.
- Divide by two for the half interval. 1 nm
- With the formula $T = \frac{D}{S}$, calculate $T$ (hours). Convert to minutes and divide by two for the time interval to the next fix. 12 min
- If the calculated time interval is less than the CO's fix interval, Recommend that CO shorten fix interval!
- Add the time interval to the fix time. This is the latest time for the next fix. 1242

CO’s initial fix interval is 15 min.

$T = \frac{1.0}{5.0} = .2 \text{ hr}$
$= 12 \text{ min}$

$1230 + 12 = 1242$

• OSTS may use distance to shoal water in the direction of travel.
Get out some scrap paper

We are going to cover some common conversions you will encounter while navigating
Converting Latitude/Longitude from Decimal to Degrees, Minutes, Seconds and vice versa

Many GPS units will display as 38° 57.5’ N

Your waypoint may be in seconds as degrees and you need to plot on a chart with seconds as decimal

Seconds as Decimal x 60 = Seconds as Degrees
Seconds as Degrees / 60 = Seconds as Decimal

38° 57.5’ N = 38° 57’ 30” N
Converting Lat/Long

- Convert the following:

\[076^\circ 05’ 45” W = XX^\circ XX.X’\]
\[076^\circ 05.75’ W\]

\[37^\circ 05’ 15” N = XX^\circ XX.X’\]
\[37^\circ 05.25’ N\]

\[072^\circ 43.50’ W = XX^\circ XX’ XX”\]
\[072^\circ 43’ 30” W\]

\[34^\circ 09.20’ N = XX^\circ XX’ XX”\]
\[34^\circ 09’ 12” N\]
**Time/Speed/Distance**

- Calculations to Memorize
  - Distance (NM) = Speed (knots) x Time (Hours)
  - 1 NM = ~2000 Yards

- Problems:
  - 3.6 NM = XX Yards
  - 8.2 NM = XX Yards
  - 6,500 Yards = XX NM
  - 15,200 Yards = XX NM
  - At 6 knots, how far will you travel in 20 min?
  - You are 8,000 yards from shoal. At 8 knots, how much time do you have before shoal?
Calculations to Memorize

- Distance (NM) = Speed (knots) x Time (Hours)
- 1 NM = ~2000 Yards

Problems:

- 3.6 NM = 7,200 Yards
- 8.2 NM = 16,400 Yards
- 6,500 Yards = 3.25 NM
- 15,200 Yards = 7.6 NM
- At 6 knots, how far will you travel in 20 min? 2 NM
- You are 8,000 yards from shoal. At 8 knots, how much time do you have before shoal? 30 minutes
• How far do you travel in 20 minutes at 7.5 knots?

2.5 nm

• You pass G “91” abeam at 1315 at 5.6 knots. How far from G”91” are you at 1400?

4.2 nm
Questions?